

ON THE
ADVANTAGES OF EXERCISE
IN SOME
SPINAL DEVIATIONS,

ADDRESSED TO

Sir *BENJAMIN BRODIE, M. D. F. R. S.*

BY

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ON

SPINAL DEVIATIONS,

To Sir Benjamin Brodie, M. D. F. R. S.

&c. &c. &c.

Dear Sir,

ON perusing your invaluable lectures on local nervous affections, I find a passage which reminds me of a conversation we had together respecting "PHYSICAL EDUCATION," when you so kindly encouraged me to write on this interesting subject. One single page of your work contains a volume, and my observations will merely extend to what you have conveyed in a few words.

" You can render no more essential service to the more affluent classes of society, than by availing yourselves of every opportunity of explaining to those among them who are parents, how much the ordinary system of education tends to engender the disposition to these diseases among their female children.

" If you would go further, so as to make them understand in what their error consists; what they ought to do, and what they ought to leave undone, you need only point out the difference between the plans usually pursued in the bringing up of the two sexes. The boys are sent at an early age to school, where a large portion of their time is spent in taking exercise in the open air; while their sisters are confined to heated rooms, taking little exercise

out of doors, and often none at all, except in a carriage. Then, for the most part, the latter spend much more of their time in actual study than the former. The mind is over educated at the expence of the physical structure."

It is unfortunately true, that when we direct our attention to the period of life at which spinal deviations are made manifest, we quickly perceive they are the result of our social state, and actual mode of education. Poor children, who inherit misery, as the rich inherit affluence, comforts and honours, are subjected to spinal deviations, arising from want of good nourishment, proper clothing, wholesome habitations, and hard and long labour.

When the wretchedness of parents leads them to neglect their offspring, diseases of the spine are common, especially during the first seven years of life; children after this time become useful, and sometimes their occupations compel them to take exercise in the open air.

Spinal complaints among the poor, caused by the influence of external and internal agents, are equally common to boys and girls, while among the rich, they are seldom known during the first years of life, and scarcely ever met with in boys; but in all classes of society, the same constitutional predispositions to diseases of the spine may exist.

When the inhabitants of large cities are debilitated by want, misconduct, disease, or excess of labour, their offspring must naturally be weak and sickly. They labour under every disadvantage, and receive a species of slow poison in the unwholesome milk flowing from the maternal breast. A proper degree of strength is not acquired, the frame is too weak to support the weight of the head and body, and the muscles lose their power of action.

But when luxury and dissipation have deteriorated the constitution of the rich, they provide strong and healthy females to nurse their infants, and the natural constitution is improved by good nourishment.

Spinal deviations are scarcely ever met with in the peasantry

who work in the open air, and cease their labour at sun-set. The principal causes of deviations among the poor, are the state of the constitution, too hard and long labour, absence of proper nourishment, wholesome air, warmth, light, and exercise; and among the rich, the state of the constitution, luxury, want of exercise, and ill-directed education.

Although there are numerous works in medical literature on spinal deviations, the attention of most authors appears to have been confined to the study and treatment of this disease at such an advanced period, that if its cure be not impossible, it is at least nearly so.

Some of the most eminent writers have made the diseases of the bones their chief study, and unfortunately these diseases are mostly incurable; fine pathological descriptions are given; cases are brought forward, all of which have terminated fatally; but no allusion is made to *slight* deviations, which are so common, generally artificial, sometimes imitative, and without material change of the organization; so that they have called forth the practices of the ignorant, and a tacit consent has been given to tortures of the limbs, more worthy of an executioner than of wise and thinking men; while proper medical advice, tending to direct the prevention of bad attitudes and bad habits, would so powerfully tend to promote the advantages of rational education.

It is of course highly important to be acquainted with the diseased state of the spine, the alterations of the cartilages, of the synovial membranes, and of the cancellous structure of the bone; but does this knowledge suffice?

If science has but little power in these diseases, if only an useless spectator of an existing evil, is it not to be deplored that learned and eminent men have spent so much time in these pathological researches, and lost sight of pursuits far more important to the welfare of society?

What opinion would be formed of a medical man who spent his whole life in study, and in giving minute descriptions of the patho-

logical state of the variola? How far superior and useful was the immortal Jenner, who discovered not only how to cure, but to prevent disease !

In April 1836, Lady —— asked my advice respecting the state of her daughter. Since November, a deviation of the vertebral column to the right towards the dorsal region was perceptible. She was brought to London for medical advice. Your opinion was asked : you thought the deviation slight, and recommended gymnastics. She should have relied on your judgment, but influenced by other ladies, she called for a quack.

When I afterwards saw the young lady, I observed a beginning lumbar deviation to the left; a dorsal deviation to the right, strongly marked, including in the curve, four or five dorsal vertebræ.

This young lady was seventeen, of a delicate constitution, but not scrofulous. During the last twelve months she had given a great deal of time to the study of the harp, and the deviation had been first observed in November, 1835.

Lady —— assured me that the deviation commenced at the dorsal vertebæ, but she at present seemed quite aware that there was a slight lumbar deviation.

I carefully felt the vertebral apophyses ; the young lady shewed no signs of pain, and there were merely symptoms of a simple deviation, caused by bad attitudes, and the greater development of the muscles to the right of the spine, arising from the study of the harp. I recommended an inclined undulated plane, which from its shape, would enable the dorsal curve to rest on the opposite curve of the unequal plane ; while the muscles on the right would be at rest, the muscles on the left would be in action; so that the gymnastic and natural extension of the body, should be combined, and in a certain time destroy the effect resulting from the study of the harp, and the bad attitudes. No bandaging, no traction, but rational exercise of the muscles, to bring the deviation to its normal state.

The accompanying plate represents the deviation, and the undulated plane I recommended.

I reasoned in the following manner: the deviation originated in bad attitudes; a contrary and well-directed attitude destroyed the first effect; all the muscles to the left of the body would acquire strength, while the muscles to the right were in a state of repose.

The upper and lower part of the vertebral column would naturally incline to the straight line by the weight of the body. The great advantage of this method was to leave the young lady at liberty, not condemn her to inactivity; she could lie on this couch with as much comfort as on any other; and I particularly advised the exercise to be stopped as soon as there was any fatigue.

During the consultation, a friend of the family arrived, and candidly said he preferred another system, though he thought my plan might prove an excellent addition.

It is but just to give publicity to the *system preferred*, that it may be taken advantage of by those who approve it. The young lady was to walk *all day* on crutches, and in the evening be strapped down on an inclined plane; her head and feet to be also bound down; she was to undergo *traction*, and was not to be suffered to move freely.

I am not acquainted with the quack who recommended this torture, and as my opinion was asked, I gave it most freely. I disapproved of the crutches and nocturnal tractions.

However, this treatment was begun, but the father of the young lady not feeling quite satisfied with the quack, who merely pretended to straighten the spine, and to have nothing to do with the state of the constitution, thought it right to take the advice of an able surgeon, and I believe called in Mr. Benjamin Travers, who also disapproved of the extension and the crutches.

I may be mistaken, and I trust it may prove so, but I should much fear this young lady will be greatly deformed; what can be the result of such various treatment; of this constant change of

system; of this constant vacillation, and want of confidence. In the first instance, you were consulted, Sir Benjamin, and then a man, who was neither surgeon nor physican. My advice was then asked, the quack was afterwards again called in, and then Mr. Travers was applied to.

It is however fortunate that you, Sir Benjamin, Mr. Travers, and myself, were of the same opinion; we neither advised crutches or nocturnal *tractions*.

It is to be lamented that parents, anxious for the welfare of their children, should be thus misguided, and allow themselves to be influenced by ignorant men. The family apothecary was always called in to consult with the physician; a similar proposition was made to the quack, who declined meeting any one; he stated that, he *only* professed to cure spinal distortion, and *had nothing to do with the constitution*; that traction, and crutches were alone necessary: such deep ignorance requires no comment.

It is to be lamented indeed, that the exercise of some branches of the medical profession have been left in the hands of individuals, strangers to the laws of our organization, and to the texture of our tissues. The merit of able practitioners, who confined themselves to a speciality, has been less appreciated than it deserved; and for this reason it has fallen into the hands of ignorant quacks.

But what subject is of deeper interest to every private family, and consequently to society at large, than the prevention of a disease, which if neglected, or mistaken, later on, baffles the power of art. I have given to spinal distortions, considerable attention, which was drawn to them by my work on the *Physical Education of young ladies*. Before I settled in London, and while preparing the materials for publication, I visited all the establishments in Paris, where spinal deviations were treated by the ablest men in the profession; I had frequent relations with them, and took every opportunity to gain information and knowledge. I saw the children, in the gymnasia, in bed, shielded with irons of all sorts. I did not confine myself to interested plans, I studied each method, each system, at M. M. Maisonnabes, Pravaz, Bouvier, Lafond, Mellet, Tavernier

Amoros, and after carefully comparing all the means employed, I gave my opinion to the public, and I now beg leave to extract some observations from my work on Physical Education.

It has been asserted that nature always has a tendency to re-establish any defect of conformation, and Rousseau has been quoted in support of this statement. He says a crooked plant will become straight if left to nature; but there are no examples of spinal deviations being cured by the assistance of nature alone: the period of growth having ceased without medical care being given, the deformity remains and becomes incurable. There are undoubtedly some diseases which may be left to nature to cure, but among them we must never place scrofula, rickets, and various natural and accidental deformities. If for instance a man dislocates and fractures his arm, and has no one to aid him to replace it, or to unite the different parts, and keep them in a suitable condition, to ward off inflammatory complications, it will then be easy to ascertain the powers of nature unaided by art.

When there is muscular and bony debility, the body has a tendency to deviation, because the muscles and bones have not sufficient strength to resist the laws of gravitation. All vertical attitudes are then dangerous, and the vertebral column must not be left to bear the whole weight of the body: a horizontal position is then really useful, as it relieves weak and growing girls from the action of weight; but there is still a constitutional state to treat.

It must be acknowledged, that the horizontal position, without gymnastic and strengthening means, might be productive of evil results; for want of exercise and proper food would keep children in a state of permanent weakness.

In muscular debility during growth, I have advised *decubitus*; where there is great weakness in the articulations of the spine, it is always desirable. The greater the progress in the study of spinal deviations, the deeper is the knowledge requisite in those who treat them; much judgment is necessary on the part of the practitioner, as cases apparently similar may demand very different treatment; for one child mechanical means may be adviseable; for another, they

should be carefully avoided; in some cases exercise, in others repose; in some, exercise and repose judiciously managed; constitutional treatment may also be advisable; and we must not only know when and how to prescribe, but what is equally essential, we must discern the share to be left to time and nature, and the share to art and science. This discernment is not the privilege of the ignorant, who think that all deviations must be treated in the same manner; unhappily the fatal results are known too late to admit of a remedy.

It is not probable that a deviation could be cured by any machine, if the patient be condemned to inactivity, Delpech observed that time and judicious care were requisite to enable the organs to bend to their new state, caused by external agents acting on the bones; and that violence might produce a morbid excitation; that at all events there should be an elastic agent until the extension cause no pain, which would also prevent danger, owing to the oscillatory returns it allowed.

All extension of the spine must be elastic; but it should be remembered that every spine will not bear traction.

On the whole, the proper treatment for muscular debility is exercise; during the period of sudden growth, decubitus; unequal development of the fibro cartilages, gymnastics and extension—we might say gymnastics and pressure, with modifications suited to the peculiarity of the case.

When deviations are caused by rheumatism, they must be treated as rheumatism, and in the absence of pain, extension is useful; deformity originating in want of muscular power may be remedied by well directed exercise; if the deformation be caused by rachitism or diseases of the bones, extension and gymnastics are out of the question; traction would bring on death.

Deviations produced by scrofula, cannot be cured by machinery, or gymnastics; but by general treatment, by a happy change in the perverted law of nutrition; by the assistance of all physical agents, air, light, good nourishment, proper exercise.*

* *Education physique des jeunes filles*, par Dr. Bureau de Riofrey. Henry Kent Causton, Birchin Lane. Dulau & Co. Baillière, Regent Street.

Such are the opinions I have emitted in the chapter on orthopedy, in my work on Physical Education. In the following chapter I have added, that the learned Delpech in his excellent work on deformities, said he would have given up orthopedy and the hope of curing certain deviations, without the use of *gymnastics*: he thought exercise could alone counteract the effects of remaining long in a recumbent posture.

More just or greater praise, could not have been given, to the advantages to be derived from medical gymnastics.

Some orthopedists are so devoted to their machinery, that they unwillingly listen to any method that may relieve children from the trammels imposed on them; straps, bandages, iron hoops, tortures better suited to criminals, have been constantly used with delicate girls, though not with impunity. No punishment inflicted in a prison can be compared to that inflicted by this machinery on innocent children. The slave trade alone can furnish examples of similar cruelty, in ships where wretched victims of cupidity are bound down or fastened, by a chain six feet long. Every one pities prisoners, but in mechanical beds the movements are more limited, the child is deprived of motion; it is a species of anticipated *death*.

Let us cast a glance on these inventions, of which the genius of Hunter and Bichat, would never have approved.

Crutches are now very seldom used; the learned Delpech rejected them, Pravaz expelled them from his establishment, they are disapproved of by the best authors. Crutches are inconvenient from their length; it is difficult to place them under the arms, still more so to keep them straight; the shoulders are bent forward, the chest is contracted, and breathing short.

Crutches must be put in an oblique direction, before they can be placed under the arm, and it is very difficult to keep them upright; every minute there is danger of falling, and what is the result of this position? The chest is pressed between two contrary powers, which tend to flatten it laterally, and to confine it at the top; how then can respiration take place? Necessarily respiration is

abdominal, and performed by the lowering of the diaphragm, for the upper sides of the chest being confined, cannot act freely. While walking on crutches, respiration is short, can hematosiſ therefore easily occur? The handles of the crutches, placed under the arm, press the tendinous part of the muscles connecting the chest and arm, I mean the dorso-humeral and the pectoral muscles; besides, the shoulder blade being elevated, the muscular part of the trapeza uniting with the back part of the head is relaxed; young persons using crutches are seldom upright, the *head bends forward*, and seems almost to touch their shoulders. It may be observed that individuals who have long used crutches, have an incurvation on the upper part of the spine, the shoulders are out, and may be compared to wings, which is considered as a predisposition to consumption. The hands and fingers swell, and are livid, the nails blue. Were there no other reasons than pressure on the gristly part of the chest and back, they would suffice to condemn the use of crutches; but to this evil may be added the injury done to the chest; and if lateral deviations could only be cured by crutches, we question whether the deviation would not be preferable to the stooping and awkward position, invariably contracted by those who use them.

The vessels, and nerves must also be pressed by the handles of the crutches. I lately visited an establishment, where the system was adopted of using crutches, and extensions by traction; I was struck by the thinness of the patients arms, the largeness of the hands; the former seemed atrophied, the latter were swelled; as to the state of the chest and shoulders, I can only say that for a child of my own, I should prefer a deviation to a more hideous deformity, produced by the use of crutches combined with serious internal lesions.

From the general considerations sketched in this letter, it is evident that the treatment of deformities of the spine, either for slight or serious deviations, cannot be founded on any general rule. To believe or to pretend that all deformities may be cured by mechanism, without considering the constitution of the patients; to apply to living bodies means borrowed from inanimate dynamic, and to expect mathematical results; in short, to straighten the spine as though it were a stick, is wholly incompatible with common

observation, good sense, scientific knowledge, and such assertions only merit silence and contempt. I have not spoken in this letter of tractions by the aid of machinery, a system which has been carried to a very great extent, and has had its partizans, and its victims. In my forthcoming work on Physical Education, I shall shew that horizontal extension, combined with spontaneous movements, without traction, bandages or torture of any kind, is the only rational method for the treatment of deformities unconnected with diseases of the bones. When I say the only method, of course I allude to machinery, for it is impossible to effect a radical cure unless attention be paid to the constitution of young ladies affected with spinal complaints,

I am, dear Sir,

Ever most faithfully your's,

22, NEWMAN STREET,
OXFORD STREET.

BUREAUD RIOFREY, M. D.

LETTER II.

To Sir Benjamin Brodie, M.D. F.R.S.

&c. &c. &c.

Dear Sir,

IF it were thought desirable to produce an artificial paralysis of an organ, or of any part of the body, without injury to the brain, or to the spinal chord, could it not be effectually done by condemning the organ, or the part of the body, to inaction? "What power, says Salzman, can the body attain, if it be not exercised?" Were we to keep the suckling "twenty years in swaddling clothes, we should have a helpless monster, a babe of twenty that could neither walk nor stand, and this merely from want of exercise." Such monsters are found in our great cities. We have a striking example of the fatal effects of want of exercise in Gasper Hauser, with whose melancholy history, most persons are acquainted. He was confined many years in a narrow and dark cell, where he was compelled to remain constantly lying down. When he recovered his liberty his limbs were so emaciated, he could make no use of them; he attempted to walk but could not even stand, and preferred crawling. He could not articulate, but after receiving a species of education, he remembered his sufferings, and managed to say that he had lived in a very small room, and that his keeper one day came behind him and guided his hand, and made him write; he afterwards taught him to stand up and walk, and taking him upon his shoulders, left him near the town of Nuremberg, where he was found.

How many young ladies blindly subjected to remain in a recumbent position during two or three years, bound down with leather straps, confined with iron bars, drawn by the head and feet with steel springs, share the same fate as Gasper Hauser! How many girls after being subjected to such irrational treatment, are unable to stand, to walk, or move alone! Their spinal column being straight, but too weak to support the weight of the body.

I shall not review the different opinions of various authors on the

causes, nature, and species of deviations of the spinal column, but merely confine myself to those points I have disapproved in my former letter,—I allude to crutches during the day, and traction during the night and part of the day. The disadvantages of inaction are so great, that even in cases of fractured limbs I would, were it possible recommend exercise: and it is the importance of exercise in fractures of the legs, which has led some surgeons to advise the use of crutches for adults.

If I wished to bring forward examples of the disadvantages of inaction, I could easily find them in your own works, and I beg to relate one case that has attracted my particular attention. A girl of eight years old was admitted in St. George's Hospital. At this time the upper part of the spine was bent forward, and the spinous processes of some of the dorsal vertebræ formed a preternatural projection at the posterior part, but still she was able to walk without assistance.

She died. The body was examined by Mr. Howship; it was universally anasarcous. *The abdominal muscles were so wasted that scarcely any vestige of them was perceptible. This probably arose from the circumstance of the child having remained in bed for so long a time previous to her death, and having scarcely ever varied her position.*

I merely quote this case which happened to lay before me, to show that you are of opinion that the want of exercise, and inaction in bed, can have a great share in producing atrophy of the muscles.

It will probably be said, that in this case, the incurvation forward of the spinal column, condemned the abdominal muscles, to inaction; if so, it is evident that inaction of the muscles, whatever may be its cause, wastes them and destroys their power; I shall take this point as granted, and will make use of it later on. But will this fact be denied? Will it also be denied that not only the muscles, but also the bones, and all the organs of the economy are weakened?

I could easily take advantage of your beautiful experiments on animals, reported in your clinical lectures on un-united fractures,

but I wish to avoid the reproach of having only a single authority, however high that authority may be ; and without spending time in researches, I hope I may be allowed to bring forward the opinion of John Shaw, on a matter in which he was so well versed.

“The effect produced upon the osseous system by want of exercise,” says John Shaw, “ may not at first be so obnoxious as the effects on the muscles, but it is occasionally exemplified in a very striking manner. If a soldier in active service receive a wound for which immediate amputation be necessary, or if the same operation be performed on a strong labourer while he is in full health and exercise, the bone is found hard as ivory and compact in structure ; but if, either the soldier, or the hospital patient should in consequence of the accident be confined to bed for some time before the leg is amputated, the bone is found soft and spongy, like that of a scrofulous person ; a remarkable instance of this is preserved in Bell’s Museum, another example is recorded by Cheselden.

This law is not confined in its operation to the muscular and osseous system, but extends to every part of the body ; thus in an ankylosed or stiff hip joint, we find that its capsular ligament, the strongest in the body, wastes and becomes a mere web of membrane, scarcely discoverable ; even the arteries lose their tubular form if the blood does not pass through them.

As a farther demonstration of the necessity of action to the preservation of a part, John Shaw mentions, that no part in physiology is better established by demonstrative proofs, than the effect, which the cessation of due exercise of function produces upon a nerve. Later on, after having exemplified the importance of exercise, he says, that in no part of the system, the law of exercise is better exemplified, than in the history of the affections of the *spine*.

“The muscles,” says he, whose office it is to support the vertebræ, may be so weakened by want of exercise as to become incapable of performing their functions ; where this takes place, the vertebræ and the ligaments which bind them together, yield to the superincumbent weight, for they are affected in a secondary manner by the same causes that have produced debility in the muscles. “ *Weakness of the*

muscles, is, therefore, perhaps, one of the most frequent forerunners of distortion, though there are many other causes: again John Shaw says—"the most probable source of many distortions is either in the cessation of the actions of some particular part, or in the undue and partial exercise of others."

To deny the impossibility, or frequency of spinal deviations, through muscular debility, or from inequality of exercise, is to oppose experience and observation. Deprive a skeleton of its muscles, and let it be seen whether it can easily be kept erect. Take from any part of the body, muscles that maintain the equilibrium, and then judge how difficult it will be to keep it in its natural position.

A young girl having the muscles of one side of the body weaker than those on the other, will find it impossible to walk straight. She is continually drawn on the side most developed. This single symptom sometimes suffices as a diagnostic to deformity or unequal development, on both sides of the body. Unless all parts of the human frame are in equilibrium, the body cannot be in its natural position. Spinal deviations often result from the efforts made to obtain this equilibrium; girls unequally developed are generally awkward in their gait and actions. Dupuytren in his clinical lectures, relates a striking example of equilibrium in all parts of the body. A young man had his wrist and part of the fore arm crushed by the wheel of a heavily loaded waggon. The fore arm was amputated. This man was a runner, and after the operation he returned to his original mode of life, but soon found he could not succeed; the arm moving incessantly served as a pendulum, and the left arm no longer counterbalancing the right, he was involuntarily drawn to the right side, and could not run nearly so fast as before the accident. Dupuytren recommended an artificial arm.

The muscular efforts made by this man alone enabled him to run, but the muscles replaced the absence of weight. In deviations, with inequality of muscular power, there is nearly always unequal developments of both sides of the body, and no attempt being made to neutralize the effects of the muscles appertaining to the side most developed, a deviation is the result of it. We must not be surprised at un-

equal development being so common to children. They write, they draw, they work with the right hand. On the piano forte, on the harp, the right hand is far more exercised than the left. An english author, struck by the power of habit in causing unequal development of both sides of the body, says, "that among the male Aborigines of London, the practice of giving the wall by the left, and taking it by the right shoulder, which originated in their narrow crowded streets, something less than a hundred years ago, has given an advance to the right shoulder, and an obliquity to the trunk, by which they are easily distinguished among other men, and which vain new comers often imitate, from an idea of these postures being fashionable. *Duffin, page 54, edition, 1829.*

We should certainly not easily have suspected the cause revealed to us by Mr. Duffin, and without sharing his opinion, it proves that he admits the great power of habit, and in habit the muscles of the body play a striking part.

The lateral curve to the right, forming the subject of this letter, is the most striking deviation; it is also most dependent on muscular structure. It must be admitted that our institutions, our arts, our habits, give more energy of action to one side of the body than to the other. The organs most exercised must be more developed, according to the great law, the general law which proves that exercise develops and increases the power of the organs. It is easy to understand that a young girl, who during growth learns to play the harp, has her right side brought forward, and all the muscles put in action, and developed, while the muscles on the opposite side are less active. This fact admitted, the deviation not originating in *ramollissement* of the bones, rachitism, or scrofula, but merely from the effects of attitudes and muscular efforts, more active and frequent on one side than on the other, ought to be treated accordingly. When the cause is at length ascertained, why not employ the same means to cure the evil as those that engendered it? For deviations arising from the imperceptible traction of the muscles, from the effect of weight, or from the incessant effort made to keep in the necessary attitude, let us imitate nature in her proceedings.

When a child plays with a bow and arrow, does he attempt to straighten his arrow by pulling both ends? Certainly not, but taking hold of the cane with both hands and placing the middle part of it against his knee, he tries to produce a contrary curve.—We propose the same plan with our *undulated machine*. The convexity of the couch represents the knee, the head and pelvis are the two extremities of the curved spine, and tend from their own weight and want of support, to reach the straight line. The muscles on the left side, the trapezius, the large dorsal, the small dorsal, the rhomboideus, the spinal muscles, and all the muscles of the thoracic region are in action to straighten the curve, and have the double advantage of developing the chest, and strengthening the muscles. In all spinal deviations where the bones and cartilages are not affected by scrofula, caries, and ramollissement, the spinal column has only given way to continual traction of muscles rendered strong by exercise; whether these muscles be directly united to the spine, or whether they take rise in a part which follows its movements. The advantages of the undulated plane, I propose, are very great, as it admits of free motion; the exercise may be taken at all hours, either in a drawing room, or in a garden.

To give strength and stimulus to the muscles which have remained inactive, and are weakened; to keep those muscles that have been too much exercised, in repose, until equilibrium be established, is both in theory and in practice, doing what is best calculated to straighten the spine, and to give to the ribs the curve appertaining to their normal state.

To want of exercise, says M. Marjolin, may be attributed most of the deformities common to children. Exercise must not be considered merely as the means of strengthening the body, and giving more ease and firmness to the movements, but it is essentially useful in the early stages of deformity, and to maintain cures performed by machinery.

M. Marjolin also observes that the permanent extension of the vertebral column, the lateral pressure acting on the thorax and on the lumbar region, are resorted to in order to lengthen the spine. This extension and pressure can never increase the action of the

weakened muscles ; neither can they re-establish the muscular equilibrium, whose cessation is in many cases, one of the first causes of the unnatural curvature of rickety persons.

If what has been here related requires confirmation, it would merely be necessary to remark those persons who have been subjected to extension and crutches. The partisans of extension, admit with great simplicity that to ensure success, the patient must always be lying down, when not walking with crutches. How then are the muscles of the body to acquire strength ; how can the spinal column afford the necessary support ? Delpech asserted that he would give up orthopedy without the assistance of gymnastics, and what orthopedist can be considered a better judge than Delpech ?

Exercise is of vital importance in spinal deviations in young girls leading a sedentary life : and the more so when their movements are confined by awkwardness, or from wearing tight or ill made stays, which weaken the muscles so as to render them unfit to support the frame.

Delpech relates that he has seen persons treated for deformity of the spine by extension only, unable to support the weight of the body without crutches. During extension, growth has been rapid, and great weakness ensued from continued extension. In a celebrated orthopedic establishment a young lady broke one of her crutches while walking in the garden, she was unable to stand or to walk a single step alone, she was carried into the house.

John Shaw not only pointed out the disadvantages of extension, but also those of long continued horizontal position. I may state, says he, that it is scarcely possible to imagine any means so effectual in preventing parts from performing their natural functions as the plan proposed for the cure of a disease originally proceeding from weakness. Indeed this now begins to be discovered, and the use of the inclined plane is gradually falling into disrepute ; for it is found that although a girl who is slightly distorted, may become more straight, after having been confined to the horizontal position for months, she does not gain strength, but on the contrary being so weak, that she can scarcely stand, or walk ; and when she attempts

to sit up without some artificial support, she sinks almost double, or at least into a state worse than she was when she first lay down. These are sufficient objections to the practise, but the effects which a long continuance of the system has upon the general health are still more serious. We find that girls who have been long confined to the reclining board, are delicate, and liable to all the worst symptoms of hysteria.

I trust [my opinion will not be misconstrued; I do not in these letters allude to any spinal deviation originating in change of structure; as ulceration of the articular cartilages, scrofulous diseases of the joints, caries of the vertebræ. In these almost incurable diseases, a state of *absolute rest must be continued for a considerable length of time*.

I have confined my observations to spinal deviations caused by irregular exercise, bad attitudes, neglected or ill directed education. I speak of those deviations existing among the higher classes of society in consequence of the mismanagement of their physical education, and of the injudicious anxiety of parents to see their daughters shine by accomplishments. I now point out the real purport of my letter, although it be evident to the most common reader, and I am led to do so by hearing parents express an opinion of their own, and give it out as your's. "Sir Benjamin Brodie," says one lady, "advised rest, and a recumbent position to an acquaintance of mine, and she derived much benefit from it." This observation being repeated, a second person says, "Sir Benjamin Brodie always recommends *continual* decubitus:" some further addition is again made by a third person. A nobleman not very long since asked you whether you approved of crutches and traction in spinal diseases, to which you replied that it depended on the circumstances of the case. The nobleman combining the ladies' gossip with his question, and your supposed opinion on spinal diseases, repeated to me, "that in spinal deviations, Sir Benjamin Brodie advised a recumbent posture, traction and crutches."

In vain did I endeavour to prove that he had misunderstood you; the gentleman maintained his opinion; and as I differed, he called in a quack; who understanding business, immediately sent in a horizontal

bed with straps, leathers, and all the apparatus worthy of Proustes, and a pair of crutches fit for a giant. He was handsomely paid for his machines, so that your misconstrued and misunderstood opinion served to protect and favor the trade of a quack. But few days had elapsed when the parents found an alteration for the worse in their daughter, and listening to the various observations of their friends, began to think they had acted very hastily, and sent for a physician who confirmed the rational opinion of his brother practitioners, and caused the quack's apparatus to be sent to the lumber room.

To resume what I said in my former letter, I must observe that to act in a contrary direction to the mode of action causing the disease, to straighten a crooked stem, and not according to the homeopathic system, to increase the evil, is the principle on which the treatment of spinal deviations originating in muscular weakness, bad attitudes, and neglected education, should in my humble opinion be founded. It now only remains for us to treat of the most rational means of curing spinal deviations, without resorting to extension, or condemning young girls to tortures and continual immobility.

I am, dear Sir,

Ever most faithfully your's,

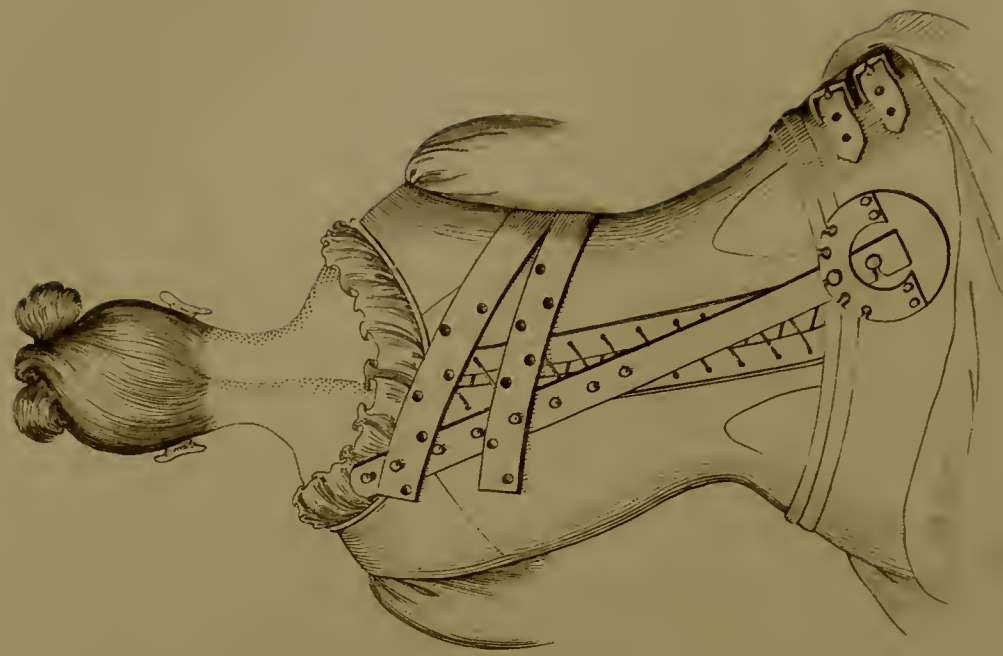
22, NEWMAN STREET,
1st JUNE, 1837.

BUREAUD RIOFREY.

Note.—The author of the foregoing letters intended to present a series of them to the public, in a condensed form; they were to contain the most rational treatment for spinal deviations. He would have pointed out the best sort of stays, belts, braces, and the various inflexible machines with which the spinal column may be brought to its normal vertical position—But his arrangements with his publisher for the second edition of “PHYSICAL EDUCATION” now in the press, prevent him from giving information which might interfere with the sale of that work: he must therefore now beg to refer his readers, who may take an interest in the subject, to the second edition of the “Physical Education of young ladies.”



FUNICULAR APPARATUS
or natural method.



MAJOCCHI'S APPARATUS
or inclining method.

LETTER III.

To Sir Benjamin Brodie, M. D. F. R. S.

§c. §c. §c.

Dear Sir,

AFTER the opinion I have given in my two former letters respecting the danger of *orthopedic* traction on beds, the use of crutches, and a continual horizontal position, it naturally follows that I reject all measures which do not admit of free exercise. Reclining on the horizontal undulated couch is an agreeable pastime for young persons; it does not confine any of the limbs, but leaves the patient perfectly at liberty: it combines all the advantages expected from the inclined planes of Shaw and Bamfield's cushions. But Dr. Pravas has gone beyond these learned orthopedists, and too much praise cannot be given to him who united in the same apparatus the benefits of gymnastics, and those of inclined planes.

I have seen several of these undulated couches at Messrs. Pravas and Guerin's establishment; and it is but just to state, that every species of improvement contained in the orthopedic art is there to be met with.

This apparatus, says Mr. Pravas, may serve as a *lit de repos*, when the patient is weary of *extension*, or else be transformed into a gymnastic machine, which answers the double purpose of bringing the spine to its normal condition, and of exercising the muscles so as to re-establish their antagonism.

It is evident, from the above observation, that Mr. Pravas has not quite given up *extension*, though he does not confine his patients to this treatment alone; and as he is most anxious to adopt every mode of improvement, we must not consider this opinion absolute, but suppose that when Mr. Pravas wrote, no better plan was known.

At a later period, Mr. Pravas observed, that he was inclined to think that patients undergoing orthopedical treatment should be

gradually prepared to stand without any support, as this was the main object in view.

It is, therefore, evident that Mr. Pravas was aware of the difficulty of maintaining an erect position, after long continued extension. This gentleman, knowing the difference between lengthening the human body and giving it strength, is by far too honourable to attempt to mislead the faculty, or parents, confiding to him their children.

Mr. Pravas then endeavours to ascertain whether there is no possibility of finding a substitute for extension, at least for a stated time.

If we give our attention to the different machines which have been in vogue for the object in question ; such as Lorraine's cross, the stems of Lavachez and La Feutrie, Chester's collar, Ambroise Paré's machinery, Portal's apparatus, Delpech's lateral belt ; Bouvier's chair, with crutches ; Pravas's elastic corset ; we shall find that all orthopedists have sought means to relieve the body from its own weight, but not to give to the muscles, by daily exercise, the strength necessary to keep the spine straight.

According to the general opinion of orthopedists, *extension* is the most desirable method of attaining this end. But how does man walk ? How does the serpent, having its body formed of innumerable rings, stand erect ? Has it crutches or belts ? Is it not supported by the sole strength of the muscles ? How is a mast drawn up and supported ?

It is certain that the spinal column, composed of twenty-four pieces, united by ligaments, tendons, and muscles, and separated by cartilages, cannot be exactly compared to a mast ; which being inflexible, is drawn up in a single piece ; and yet man can only stand erect by the aid of muscles and levers, which represent the ropes that fix and strengthen a mast. Each part of the spinal column is drawn by particular muscles ; when once erect, each vertebra is a support for the other ; it is not then a single mast drawn up, but so many pieces, the whole of which forms but one mast and jointed column kept erect.

If the muscles be weak on one side, the spine inclines that way ; the body then endeavours to find its equilibrium, by leaning on the opposite side ; the muscles are in continual activity ; neither stays nor crutches can support the body ; the head, arms, and other parts of the body must be put in action, to maintain the equilibrium.

Some historians relate, that in the time of Sixtus Quintus, a fine obelisk was brought from Egypt, and put up in Rome. The power of steam was not then known ; the obelisk was not straight, and the ropes being already much stretched, it was not judged prudent to draw them tighter. A man, in the crowd, called out to wet them ; the next day the obelisk was straight.

The practice of wetting the cords is very common on board ship, and seems to indicate what should be done for the muscles of the human body. Bring into the weak muscles and cartilage, the nourishing sap destined to fill the cells ; let the muscles be imbibed with nutritive elements ; do not allow them to be continually stretched, but give them all possible strength ; and as this essential point cannot be attained without exercise, this important object must always be taken into consideration in every thing relating to orthopedy. What can be expected from those tight stays, confining the body, and preventing free motion ; will they give strength to the muscles ?

The most celebrated orthopedists, though they had solved the problem of spinal deviations, when they strongly recommended extension to be local, so as to fatigue as little as possible the healthy parts of the spine, and to concentrate all extension to the curvature, and to combine muscular exercise with extension, so as not to leave the body in continual inactivity. But could this extension be local on a few depressed cartilages ; and then again did the muscles require extension to maintain the equilibrium of the spine ? and the deviated part being stretched, is it not naturally weaker ?

Orthopedists felt there was something wanting ; that their method was defective, and that there was much to be said against it ; and they sought to make up for the evident deficiency, by proposing to combine exercise with extension.

The support extension had hitherto received was undoubtedly a drawback to improvement in the art of rectifying spinal deviations. M. M. Guerin, Pravas, Bouvier, Maisonabes, follow the same principle, with very slight differences; the one recommends extension and muscular exercise; the other extension, crutches, arm chairs, supporters.

M. Hossard then appeared with his reclining system, and brought down upon himself the direful wrath of orthopedists; for what was to become of them, if expensive mechanic beds were dispensed with; and what patients could they expect, if Mr. Hossard's method was adopted?

But while all orthopedists were in favour of extension, M. Hossard rejected it. Instead of pulling both extremities of a curved stem, in order to straighten it, M. Hossard presses on the summit of the curvature, and it is not a foreign agent which rectifies the vertebral column, but the muscular action caused by the laws of equilibrium.

To banish extension in the treatment of lateral curvatures; to substitute complicated and expensive machinery for a simple, and cheap apparatus; to reject bands, belts, corsets, and to reprobate extension and traction, to which young girls are so wantonly subjected, is undoubtedly to render an important service to humanity and science.

But is this progressive step the last hope of improvement in orthopedy; is there no objection to be made to this method? Does not this inflexible stem placed behind, affect the motion of the body, and may not the double belt fastened to the stem, prevent free respiration? When the spinal column is twisted, is there reason to hope that traction will rectify the twist? I think not, and in giving all due praise to M. Hossard, I am nevertheless of opinion that he has not reached the degree of perfection that may be sought in orthopedy.

I was lately conversing on this branch of scientific surgery, with a french civil engineer, M. Duvergier; and was so forcibly struck by the clearness of his ideas, and the simplicity of the means he suggested, which seemed to me to surpass any yet given, that I

begged this gentleman to favor me with a written statement of his views, wishing to make them known to those who study orthopedy, and I have had them translated for the benefit of my readers. In my former letters I have fully expressed my aversion for mechanical beds, traction, and extension, and as my opinion corresponds exactly with that of the gentleman above mentioned, his observations only tend to confirm the statements I have already made.

I terminated my last letter by saying that to act in a contrary direction to the mode of action, causing the deviation of the spinal column; to straighten a crooked stem, and not to increase the evil, is the principle on which the treatment of spinal deviation, originating in muscular weakness, bad attitudes, and neglected education, should be founded.

“Every art,” says M. Duvergier, “is a cyclopedia of all other arts; all human knowledge is useful to the medical man; and in the present day, both the success and failures in surgery are proofs of this truth.

Mechanism opens a new career to operative medicine; and for the last twenty years it has tended to prevent, conceal, and cure human infirmity. The greatest obstacle to the progress of human knowledge is profit. For the practitioner and the patient, the main object is a cure; but for the spinal operator to boast of a method, and carefully to conceal his secret, is success.

Deformations result from modifications occurring in the length of the muscles, and on the surface of bony articulations.

The object of orthopedy is to replace the patient in her normal state, so that time may re-establish the disorders of the relative positions. Europe has judged the barbarous method of extension. Gymnastic may prevent, but does not cure deviations; it develops the power of certain muscles, without changing their proportion; and deformation is a question of length.

The remedy is therefore to be found in *pressure*, but deformation is never single; it not only modifies the length of the muscles, and the surface of the osseous articulations, but changes the proportions

of the cavities and the viscera they contain ; it destroys the natural equilibrium, to re-establish which the head, arms, legs, take new positions, and it is only gradually that the injury can be remedied ; violence would endanger the whole organization.

The funicularis method answers all the requisite orthopedic purposes.

The direction and proportions of deformations are infinite, but all are either tortionary, direct, or composed. If the left shoulder be too forward it must be drawn backwards by an elastic string fixed to the right hip, the equilibrium will be destroyed, and to restore it the other shoulder will come forward.

If the left shoulder be too high the elastic strings of the left hip, one behind and one before, will force it down, and the opposite shoulder will rise in proportion.

If the left shoulder be out, the elastic strings of the right hip will bring it in, and force the opposite shoulder out.

If the strings be elastic, the patient will gradually recover her normal shape, and during the treatment, is left in full possession of all her faculties, and her health is in no way affected."

These observations require no commentary. The application of this remedy is easy, attended with no danger, and the result certain. There is a fact in physiology that no one will dispute ; we all seek to avoid pain. If there be discomfort in one part of the body, we naturally seek for ease. In the funicularis method there is not only discomfort for the extra-developed side, but gradually drawing it in a different direction, the body cannot maintain its equilibrium without muscular effort, and these efforts bring forward the nourishing sap which strengthens and shortens the muscles that support the equilibrium of the body. The wide difference between the funicularis system, and that of the ancient and modern orthopedists, is that the latter do not admit the possibility of straightening the vertebral column, without lengthening it, and drawing the extremities ; but we imitate the poor man who taught the Romans the power of funicular imbibition. We compare the muscles to ropes ;

in deviations, these ropes are too much stretched on one side, not sufficiently on the other; our aim is to give them equal power. If a skeleton cannot be kept erect without the assistance of muscles; if the human equilibrium be destroyed because all the muscles are not in their normal state, how can so little attention be given to the part they play in causing deviations and in producing a cure? I believe I fully explained in my first letter, that I did not here treat of diseases of the bones, and I shall now merely add that by the funicularis system spinal distortions may be cured, and that hitherto no other method has succeeded.

I regret that my previous engagements do not permit me to continue these letters, and to give to this interesting subject, the necessary development, but these details are in the second edition of my work on Physical Education of young ladies, in which I have treated the question of orthopedy so as to render it useful, not only to medical men, but to all mothers and governesses. Serious and complicated cases may necessitate professional assistance, but good sense and correct observation suffice to counterbalance the evil effects of ill directed education, bad habits, and slight deviations. For the future, instead of mechanical beds, iron bars, heavy belts, a few ribbons will alone suffice, and these seem to us the only ties adapted to the delicate figures of young ladies, bred and born in large cities.

I am, dear Sir,

Ever most faithfully your's,

22, NEWMAN STREET,
1st JULY, 1837.

BUREAUD RIOFREY.

APPARATUS FOR ARRESTING HEMORRHAGE AFTER THE EXTRACTION OF TEETH.

BY DR ROBERTS, F.R.S.S.A., &c.,
DENTIST AND SURGEON; DENTIST TO GEORGE HERIOT'S HOSPITAL, ETC.

Extracted from the Monthly Journal of Medical Science.—May 1846.

It is well known, from the published reports of cases, and from the experience of many surgeons as well as dentists, that alarming hemorrhage has occasionally followed the extraction of a tooth, even when so loose in its socket, as to require little force or dexterity for its removal. In the great proportion of such cases, the bleeding is the result of an hemorrhagic diathesis. In the same individuals, a slight scratch or an abrasion on any other part of the body might have evinced the morbid tendency; but the locality of the injured surface, with its heat and moisture, greatly favours the bleeding process. The situation, also, presents no inconsiderable obstacles to the arrest of the hemorrhage, and hence the difficulty which has been experienced in so many instances, and the fatal result in not a few.

The actual cautery, caustics, and styptics, such as the sulphates of alumina and zinc, the acetate of lead, the protonitrate of mercury, turpentine, kino, &c. have, together with the constitutional treatment usually employed in hemorrhagic cases, been on too many occasions of no avail; and it now seems to be the decided conviction of the profession, that the speediest and most efficacious mode of arresting an alveolar hemorrhage is by *direct pressure upon the bleeding point*.

In some cases, I have succeeded in accomplishing all that was desired, by the continued pressure of the finger on a dossil of lint placed in the socket; and in others, by a cork placed over the plug, and a bandage round the head tying up the jaws. But while the former mode cannot always be continued for such a length of time as is required, the latter is attended with many disadvantages; it is a practice not without danger; and has proved utterly inefficacious, in several melancholy instances.

Since the death of a young gentleman in 1842, whose case was read to this Society by the late Dr Hay, and afterwards published in the MONTHLY JOURNAL, (March 1842, p. 264,) my attention has been strongly and anxiously directed to this subject, with a view to devise an apparatus, by which continued, steady, yet gentle pressure might be applied to the point from which the bleeding proceeds; and the compresses which I am now permitted the favour of laying before your Society are the result. As yet they are unproved, but I trust, that

when an opportunity occurs for testing them, they will be found, with slight alterations at most, to answer the purpose for which they are designed.

The compress for the lower jaw, from the nature of the parts engaged, is simple compared with the one for the upper jaw. It is, in fact, an artificial finger and thumb. In applying it, the first thing to be attended to, is a thorough cleaning out of the cavity of the alveolus from which the bleeding issues; it is then to be firmly filled with dry lint. The moveable cross bar being kept at the furthest extremity of the apparatus, the bolster or pad is brought to rest under the jaw, on that side of the mouth which is affected; and the branch is afterwards carried into the mouth, and the stopper or saddle made to bear directly on the plug of lint filling the alveolus. The cross bar is now moved towards the chin, and the screw at its extremity is turned to effect the necessary pressure, which should just be firm enough to maintain the steadiness of the apparatus.

The compress for the *upper jaw* is, of necessity, more complicated, and at first sight may appear somewhat formidable: it is, however, of very easy application. It may be divided into three parts—a shield or plate with straps, to be secured to the head;—a perpendicular bar, to be secured to the shield;—and a sliding transverse bar, bearing the stopper or saddle. The shield is to be placed on the side of the head, or over the forehead, as need be, or the side from which the bleeding proceeds, and made quite steady by the straps; but so as not to occasion painful pressure. The bleeding alveolus is now to be carefully cleaned out and plugged with lint, as recommended in the application of the compress for the lower jaw. The perpendicular bar is then to be slid through the groove or notch in the shield, and carried up, until its lowest extremity is brought in a line with the teeth of the superior maxilla; the cross sliding bar having been inserted in the mouth to a requisite length, so as to bear directly on the alveolar plug, the thumb screw attached to its extremity, and the one in the shield are then to be tightened, until a proper degree of pressure is obtained. I would recommend that the lowest screw should be kept at its greatest length, to allow increased pressure, if required; and in the case of either compress (should any point appear to be insufficiently closed,) a small piece of lint may be introduced, without shifting the apparatus; or, should any slackness occur in the absence of the surgeon, the patient himself, or a friend, may firm the screw a little more with advantage. If thought necessary, a strap may be passed round the face, across the upper lip, and attached to the lowest extremity of the perpendicular bar, so as to effect a degree of counter pressure, and give additional steadiness to the apparatus.

All must be aware, that the ordinary method of applying pressure to stop an alveolar hemorrhage, is to fill the socket of the tooth with lint, to place a cork over the plug, and then to tie up the jaws immediately with bandages. If the bandages are firm, from the length of time during which they must be retained, the patient experiences much

suffering and annoyance, for the constraint of the mouth and face frets him exceedingly, and the heat which is produced in the head, increases the tendency to a local determination of blood. And besides, if sickness supervene, the act of vomiting cannot but be most painful, if not absolutely dangerous.

The great uneasiness thus produced must soon lead to a little slackening of the bandages, and thus, in some instances which I have witnessed, while to appearance all seemed secure, hemorrhage was going on in secret, and blood was running down the throat in a full stream, or forming large clots in the mouth, which in turn served as a poultice to the bleeding vessel.

In the case to which I have already alluded, pressure *newly* applied always restrained the hemorrhage for a time; but the pain and annoyance which the patient suffered from the bandages induced an involuntary effort to obtain relief; and the bandages thus becoming loose, the blood flowed as much as ever, and this occurring frequently, much valuable time and strength were lost. Even in this case, I am inclined to think, that had an early gentle pressure been applied to, and steadily maintained on the precise point from which the hemorrhage proceeded, without the intervention of other means, the result might have been favourable.

But to conclude:—While I am so sanguine as to believe, that the compresses which I now recommend, are fitted to secure the kind and degree of pressure most desirable, I also anticipate a very great advantage from the freedom of the mouth,—a freedom which is most agreeable to the patient, and permits the surgeon at any time to inspect it. Thus, should hemorrhage be ascertained to be going on, an alteration in the plug, or in the position of the stopper, may be easily accomplished; and at the same time, other applications may be employed, and nourishment administered, without disturbing the apparatus in the least degree.*

POSTSCRIPT.

March 13, 1846.

Since this paper was read before the Society, I have had an opportunity of *testing* the compress for the upper jaw, and with perfect success. On the 11th of this month, (Wednesday,) one of my assistants

* Dr Peddie exhibited the two compresses to the Society, and explained the mode of applying them, making use of a skull for that purpose. He then stated that the instrument had been laid before the Royal Scottish Society of Arts some time since, when a very favourable report was returned, and the Honorary Silver Medal awarded to Dr Roberts. The instrument had been inspected by several eminent members of the profession, who had bestowed on the invention unqualified approbation. Since then it has been made much more light and convenient.

Dr Peddie concluded by stating, that within the last ten years, he had met with three cases of excessive hemorrhage after the extraction of teeth; that he believed the dentists who had operated had done so with great care; that he (Dr P.) in the after treatment of these cases, had experienced all the difficulties which Dr Roberts had described as attending the use of the ordinary local and general means; and was convinced that the possession of such a compress would have enabled him to restrain the hemorrhage early and easily.

removed a molar of the upper jaw from a morning patient, Thomas Russel, shoemaker, 116 Crosscauseway, about 30 years of age. The tooth came clean away, and the hemorrhage was nothing more than usual; but from that time to the 13th of the month (Friday,) it had not ceased, and when he presented himself, the bleeding was very active. He had naturally become alarmed.

I plugged the bleeding alveolus firmly with lint, and then placed on it the compress. The hemorrhage was at once checked; nor did he lose a drop of blood afterwards, while the compress was on, a period of four hours, and when he left, there appeared no further cause of alarm. During the time the compress was applied, the patient felt no pain whatever from the pressure, and but little inconvenience otherwise; while I had perfect freedom in examining the mouth from time to time.

He informed me, that he had had two teeth extracted at a former period, and that after each extraction he had lost a great deal of blood, the hemorrhage continuing several hours after each operation.

Saturday 14th. No further hemorrhage.

DESCRIPTION OF THE PLATE.

FIG. 1.

- A. Shield.
- B. Perpendicular bar.
- C. Transverse bar and stopper.
- D.D.D. Regulating screws.

FIG. 2.

- A. Bolster.
- B. Stopper.
- C. Regulating bar and screw.

FIG. 3.

Additional strap for counter pressure.

FIG. 4.

Stoppers.

FIGS. 5 and 6.

Method of application.

Fig. 5.



Fig. 1.

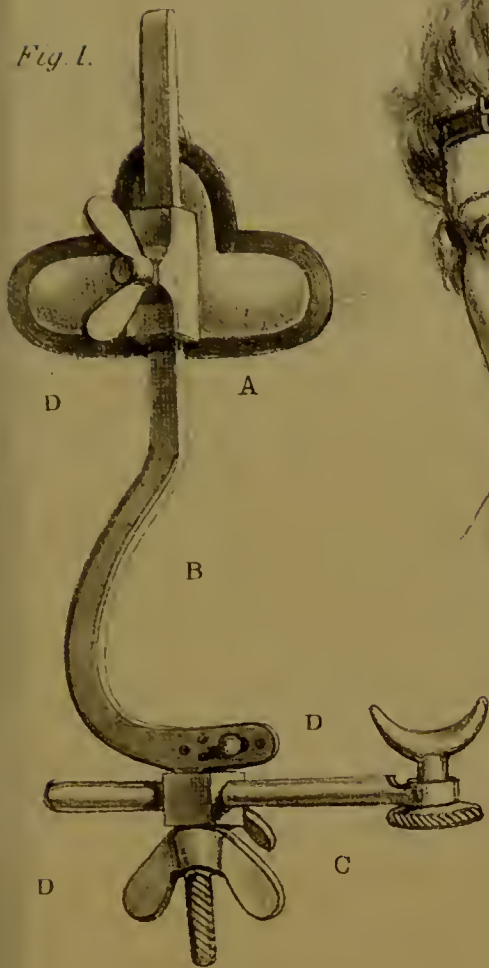


Fig. 3.



Fig. 6.

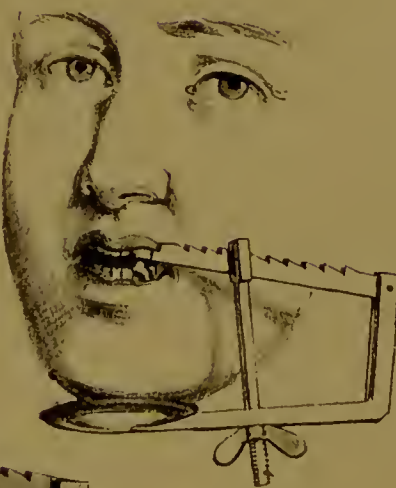
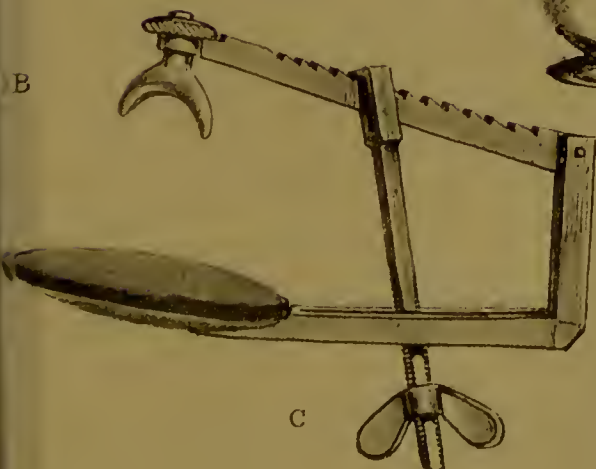


Fig. 4.



Fig. 2.



Dr. Roberts' Compress

